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RESEARCH NOTES
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Benefits of fertilization for white spruce and lodgepole pine trees depend on the reclamation substrate – overburden vs tailings sand

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The Challenge

During reclamation of oil sands mines, overburden or tailings sand substrates are often capped with a peat mineral mix. These soils can exhibit a number of challenging properties, including low availability of water and nutrients such as nitrogen.

Some trees planted on oil sands mines have started to show reduced growth and yellowed needles – signs of nitrogen deficiency. This study sought to determine the growth responses of white spruce and lodgepole pine to fertilization in reconstructed boreal forest soils.

The Approach

Fertilization impacts were studied on two sites typical of the oil sands region of Alberta. The sites were 20-25 years old and had a minimum of 20 cm of peat mineral mix placed over tailings sand or overburden substrate.

Trees were planted on the sites two years after land construction. White spruce was planted on the overburden substrate capped with peat mineral mix. Lodgepole pine was planted on the tailings sand substrate capped with peat mineral mix.

Three white spruce and three lodgepole pine plots that showed restricted growth rates were selected for study. Fertilizers (nitrogen-only and complete fertilizer) were broadcast applied within two metres of each tree (i.e., a single-tree fertilization trial). The complete fertilizer treatment included nitrogen and other macronutrients as well as micronutrients required by the trees. Tree height, diameter at breast height and above ground biomass were then monitored for two years following fertilizer application.

The Results

Nitrogen and complete fertilizer applications both improved growth of the white spruce on sites with an overburden substrate. Because the white spruce responded the same way to both fertilizer treatments, it confirms that nitrogen was the limiting factor for growth on the reclaimed site.

Fertilization did not, however, have an effect on lodgepole pine growth on sites with a tailings sand substrate. This suggests that other factors, such as water availability, were limiting lodgepole pine growth. A companion study confirmed that water availability limited the growth of lodgepole pines on the studied sites.

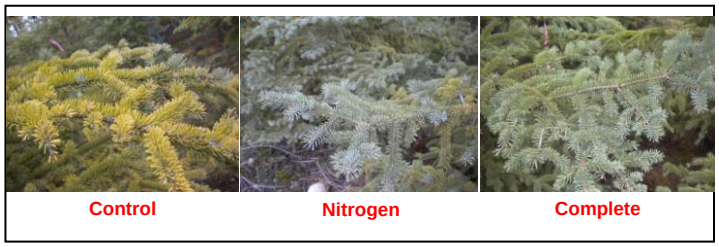

Fig. 1 Examples of white spruce needle colors observed during the trial.

Management Implications

- White spruce trees planted on overburden materials will benefit from application of a nitrogen fertilizer. The effects of fertilization are likely to be short term.
- Placing thicker layers of cover material over tailings sand or developing alternative soil reconstruction designs may help to increase the water holding capacity due to the higher organic matter content or new soil profile configurations.
- Additional studies are required to test how to correct for growth limitations of lodgepole pine trees planted on soils with tailings sand as a substrate.

Further Reading

Duan, M. and S.X. Chang. 2015. Responses of lodgepole pine (*Pinus contorta)* and white spruce (*Picea glauca*) to fertilization in some reconstructed boreal forest soils in the oil sands region. Ecological Engineering 84:354-361.

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